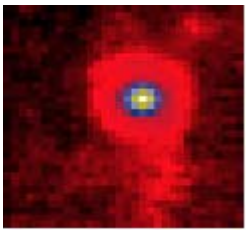
AstroBiology Explorer

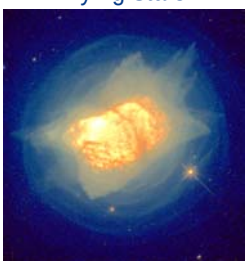
The First Explorer Mission Dedicated to Astrobiology

Principal Investigator: Dr. Scott Sandford, NASA Ames Research Center

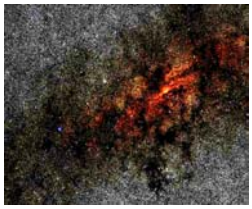
Galaxies



Dying Stars



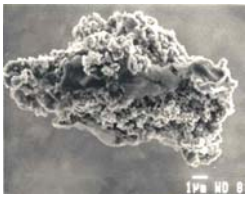
Interstellar Medium



Dense Clouds

Comets

Cosmic Dust



Summary of Proposed Investigation

The Astrobiology Explorer (ABE)—the first space mission devoted to astrobiology—will systematically study the nature, evolution, and distribution of organic molecules in the local universe and assess the role of extraterrestrial organics in the development of life. ABE will use a cryogenically cooled 60-cm diameter telescope equipped with a spectrometer covering 2.5 to 20 μm at a spectral resolution of $\lambda/\Delta\lambda \geq 2{,}000$ to measure the mid-infrared spectrum of approximately 1,600 objects of astrobiological significance.

Science Objectives and Relation to NASA Goals

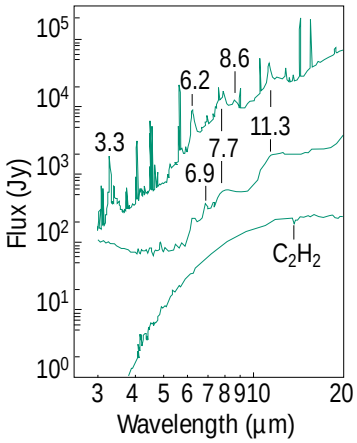
Where Do We Come From? Are We Alone? ABE will address these two defining questions of the NASA Origins' program using IR spectroscopy to explore the identity, abundance, and distribution of molecules of astrobiological importance throughout the universe.

ABE responds directly to many of NASA's key Origins Science Roadmap and Astrobiology Roadmap goals. In particular, it will address issues associated with:

- How galaxies and stars form, evolve, and interact
- The roles presolar materials play in the formation of planetary systems and the origin and evolution of life in these systems
- How common life may be elsewhere in the universe

ABE will address problems in astrobiology, astrochemistry and astrophysics with an observational program that will:

- Investigate the evolution of ices and organics in dense clouds and star formation regions, and the young stellar/planetary systems that form in them
- Measure the evolution of complex organic molecules in stellar outflows
- Study the organic composition of a wide variety of solar system objects including asteroids, comets, and the planets and their satellites
- Identify organic compounds in the diffuse ISM and determine their distribution and abundance
- Detect and identify organic compounds in other galaxies and determine their dependence on galactic type
- Measure deuterium enrichments in interstellar organics and use them as tracers of chemical processes



Typical IR Spectra Data Product

IR spectra hold the keys to the molecular composition of the universe

Mission Overview and Goals

The ABE Observatory will be launched in June 2007 into an Earth-trailing, heliocentric orbit. The flight profile is straightforward, with no maneuvers after separation from the Delta II launch vehicle, no mission-critical events requiring autonomous onboard decisions, and no significant launch window constraints. Following a 30-day period during which the ABE instrument (telescope, cryostat, and spectrometer) and spacecraft are characterized, ABE will begin acquiring scientific data. ABE will study a wide variety of targets, selected for their important roles in defining the evolution of organic and related materials in space. The scientific goals of the baseline mission can be achieved in 14 months of observation. The Observatory has significant cryogen and propellant lifetime margins.

Mission Management: The ABE Team

ABE will be led by Principal Investigator Dr. Scott Sandford, managed by JPL, and built by Ball. Science operations will be carried out at ARC and the ABE database will be archived at IPAC.

Principal Investigator:	Dr. Scott Sandford, NASA Ames Research Center (ARC)
Project Management:	Jet Propulsion Laboratory (JPL)
Industry Partner:	Ball Aerospace & Technologies Corp. (Ball)

Opportunities are provided for guest observers

Co-Investigators and collaborators are from universities, industry, and government.

Louis Allamandola	NASA-ARC	Steven D. Lord	IPAC/Caltech
Jesse Bregman	NASA-ARC	Suzanne Madden	Service d'Astrophysique
Martin Cohen	UC Berkeley	Craig McCreight	NASA-ARC
Dale Cruikshank	NASA-ARC	Thomas Roellig	NASA-ARC
Christophe Dumas	JPL	Donald Strecker	Ball
Kimberly Ennico	NASA-ARC	A.G.G.M. Tielens	Kapteyn Astronomical Institute
Thomas Greene	NASA-ARC	Michael Werner	JPL
Douglas Hudgins	NASA-ARC	Krisstina Wilmoth	NASA-ARC
Sun Kwok	University of Calgary		

Ames Research Center

JPL

Ball

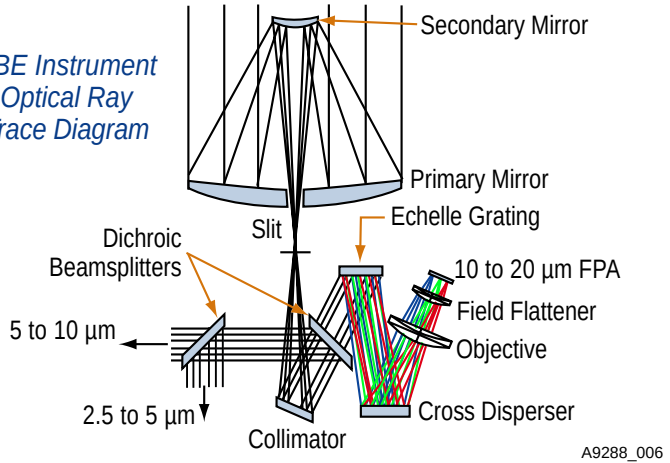
Education/Public Outreach

The ABE Mission Principal Investigator, Dr. Scott Sandford, and the entire ABE Science Team is dedicated to supporting a rich E/PO program. The ABE E/PO program includes participation of six different institutions whose efforts are organized by Ms. Krisstina Wilmoth of the NASA Astrobiology Institute. The ABE E/PO program will give students and teachers opportunities to interact with the Science Team and participate in the mission, and will produce a number of new eductional resources.

ABE Science Payload Key Facts

Telescope Diameter	60 cm
Payload Mass	378 kg
Cryogen	Solid hydrogen, 40-mo lifetime
Telescope Temperature	<8 K
Wavelength Coverage	2.5 to 20 µm
Spectral Resolution, $\lambda/\Delta\lambda$	R=2,000 to 3,500
Slit Dimensions	8.3 arcsec x 100 arcsec (obtains simultaneous, co-spatial spectra at all wavelengths)
Focal Plane Array (FPA) and Format	InSb, 2x Si:As; 1024 x 1024 pixels per array
FPA Temperatures	15 K (InSb), 7.3 K (Si:As)
Sensitivities 1-σ in 1000s (mJy)	0.08 @ 2.5 µm, 0.16 @ 5 µm, 1.3 @ 10 µm, 1.6 @ 16 µm

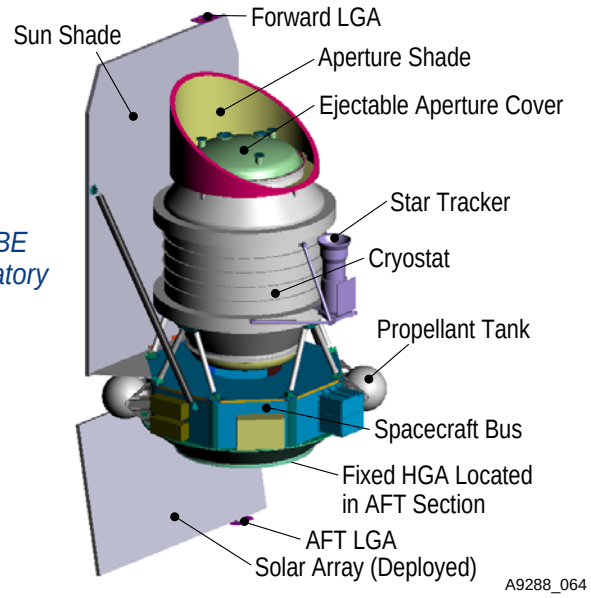
ABE Instrument Optical Ray Trace Diagram



A MIDEX Mission: Cost and Schedule

The ABE Mission fits within $TBD (FY'02) cost cap. The addition of JPL's management and systems engineering cost of $TBD brings the total ABE cost to $TBD. The ABE project schedule, showing the major activities in the development, implementation, and operation, is shown below.

The ABE Observatory



ABE Spacecraft Bus Characteristics

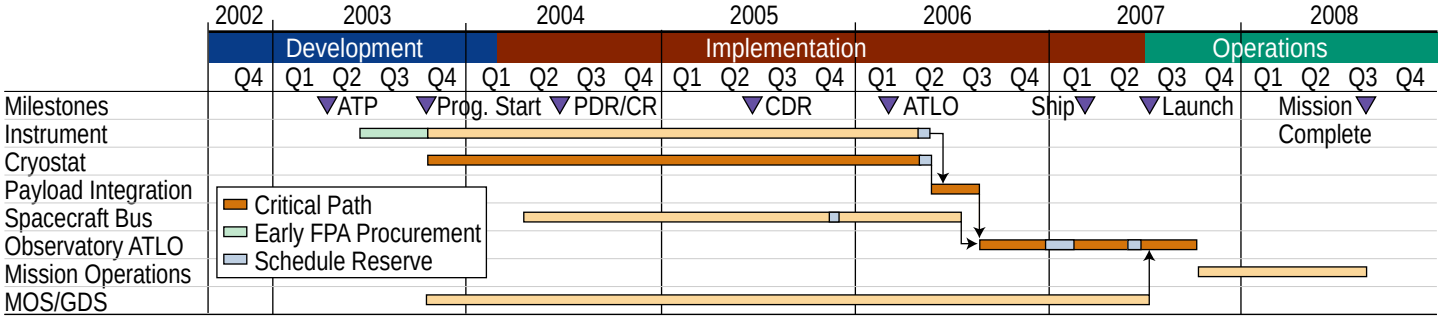
Solar Array Type/Size	Unarticulated rigid panel, 2.0 m²
Array Power	EOM 354 W
Solar Cell Type	Triple Junction (26.8% efficiency)
Battery Type, Capacity	Li-ion, 36 A-h
Data Storage	32 Gbits
Max Record/Playback Rate	3.4 Mbps/2.2 Mbps
Telecommunications	X-band up/down 25 W
Data Rates - Up/Down	2.0 kbps/1 Mbps
Attitude Determination	Star tracker, IRU
Attitude Control	3-axis Z.N.M.
Pointing Accuracy	1.5 arcsec (3 sigma)
Propulsion/RCS	Cold-gas nitrogen (fully redundant)
2 Deployables	Aperture cover, rigid solar panel

Launch Vehicle

The spacecraft is launched on a Delta 2425 launch vehicle into an Earth-driftaway heliocentric orbit, chosen because of its stable thermal environment.

Major Mission Characteristics

Launch Date (Nominal)	June 1, 2007
Launch Vehicle	Delta 2425
Launch Window	Twice per day, no seasonal restrictions
Observatory Total Mass	615 kg
Mission Duration	1-mo checkout plus 14-mo science ops
Orbit Type	Earth-trailing, heliocentric
Max Earth Range	0.13 AU



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